Progress towards implementing a remote vicarious ocean color calibration site, MarONet

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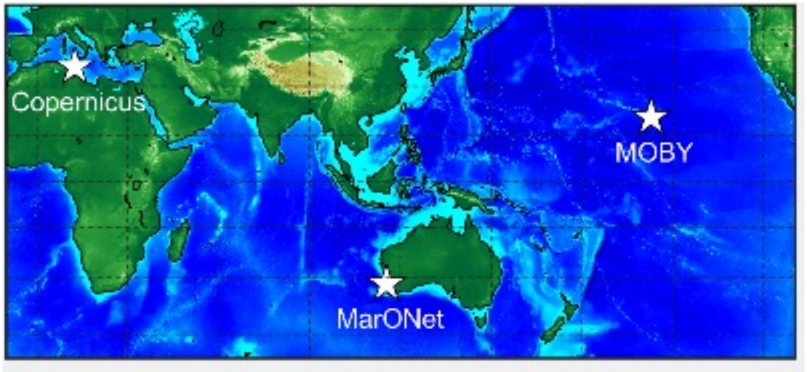
Objectives:

1st period (7/1/20-12/31/21), to prove the suitability and applicability of the MarONet system for use as the primary OCI/PACE Vicarious Calibration data source. Building on previous work under MOBY-Net.

2nd period (1/1/22-12/31/22), Develop an ocean color vicarious calibration site in Perth, Australia.

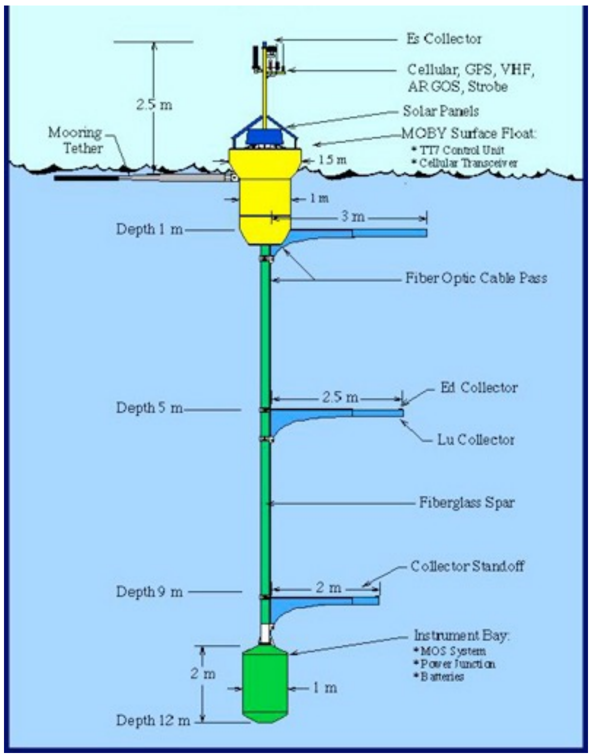
3rd year and beyond: Provide Vicarious Calibration data to the PACE science team, upon the launch of PACE to quickly and accurately calibrate the OCI instrument on the PACE platform

Possibility of having very similar systems, in three locations in the world to provide continuous Ocean Color Satellite calibration/validation.

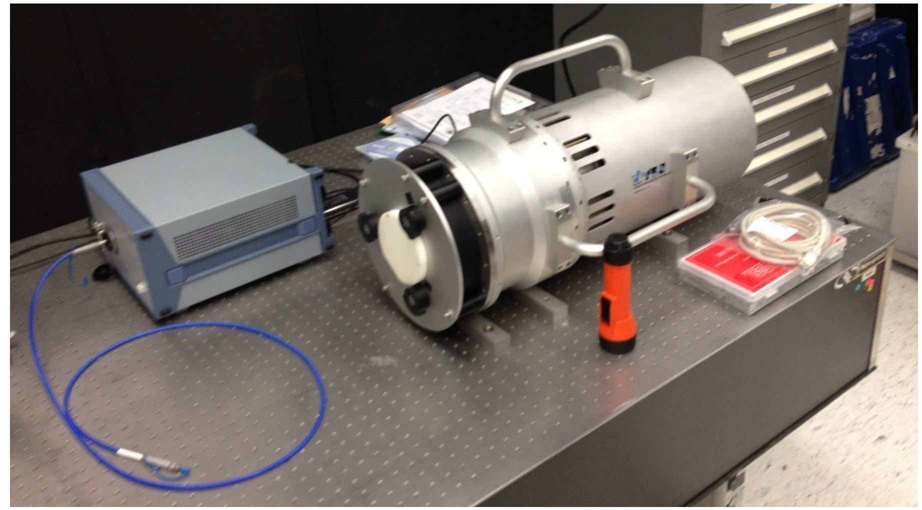


What does the MarONet system look like?

Three pieces: MarONet Optical Buoy itself, Stability source, Stability monitor

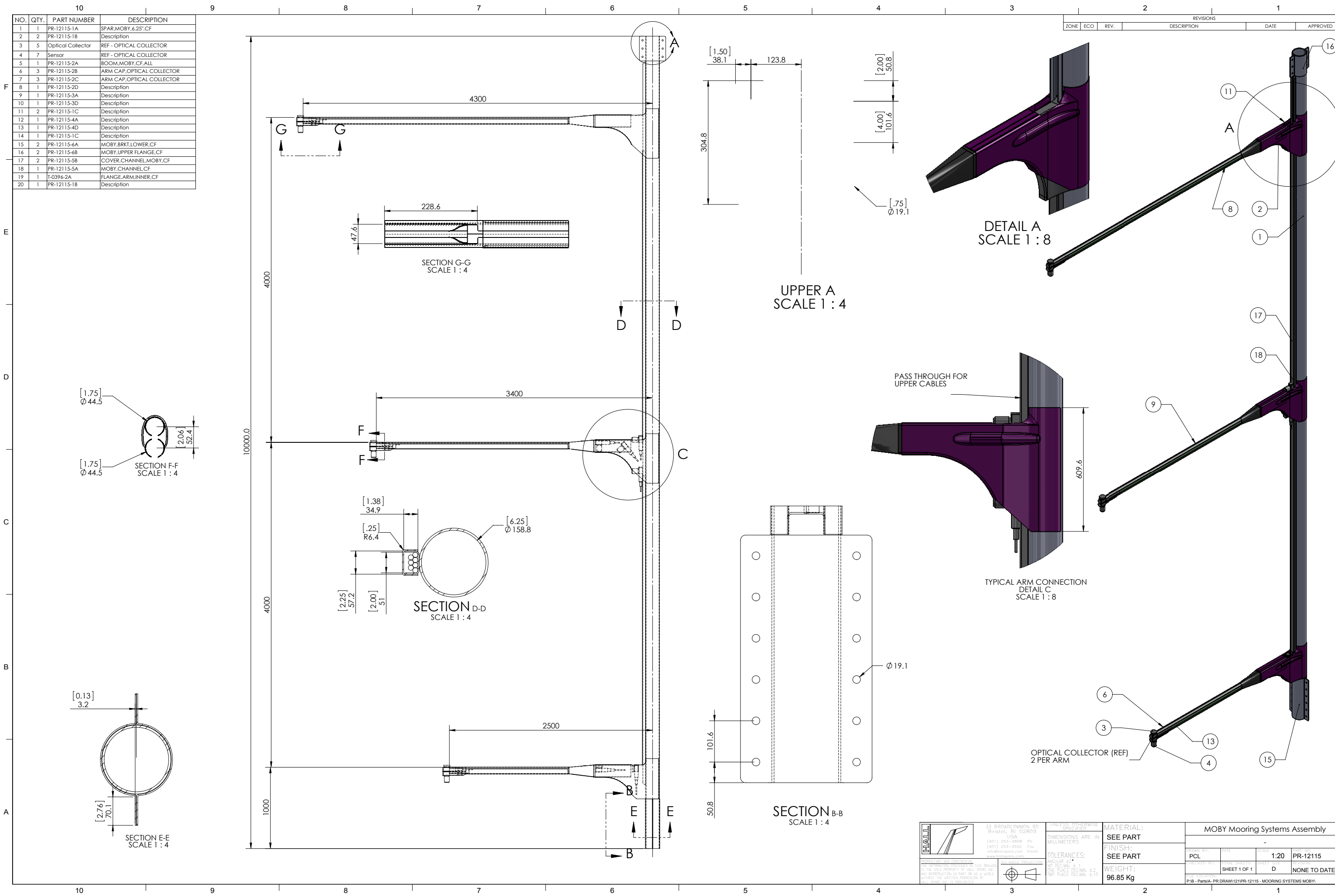


MarONet overall structure the similar to MOBY, with upgraded optics/electronics/control system



To allow shipment of optical system to/from our Calibration facility in Hawaii we have a stability source (can on right side) and stability monitor (box on left), which we have been testing and modifying. This system is used with the optical system, before and after shipping to maintain/confirm the calibration.

MOBY Hull



NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	PR-12115-1A	SPAR,MOBY,6.25",CF
2	2	PR-12115-1B	Description
3	5	Optical Collector	REF - OPTICAL COLLECTOR
4	7	Sensor	REF - OPTICAL COLLECTOR
5	1	PR-12115-2A	BOOM,MOBY,CF,ALL
6	3	PR-12115-2B	ARM CAP,OPTICAL COLLECTOR
7	3	PR-12115-2C	ARM CAP,OPTICAL COLLECTOR
8	1	PR-12115-2D	Description
9	1	PR-12115-3A	Description
10	1	PR-12115-3D	Description
11	2	PR-12115-1C	Description
12	1	PR-12115-4A	Description
13	1	PR-12115-4D	Description
14	1	PR-12115-1C	Description
15	2	PR-12115-6A	MOBY,BRKT,LOWER,CF
16	2	PR-12115-6B	MOBY,UPPER FLANGE,CF
17	2	PR-12115-5B	COVER,CHANNEL,MOBY,CF
18	1	PR-12115-5A	MOBY,CHANNEL,CF
19	1	T-0396-2A	FLANGE,ARM,INNER,CF
20	1	PR-12115-1B	Description

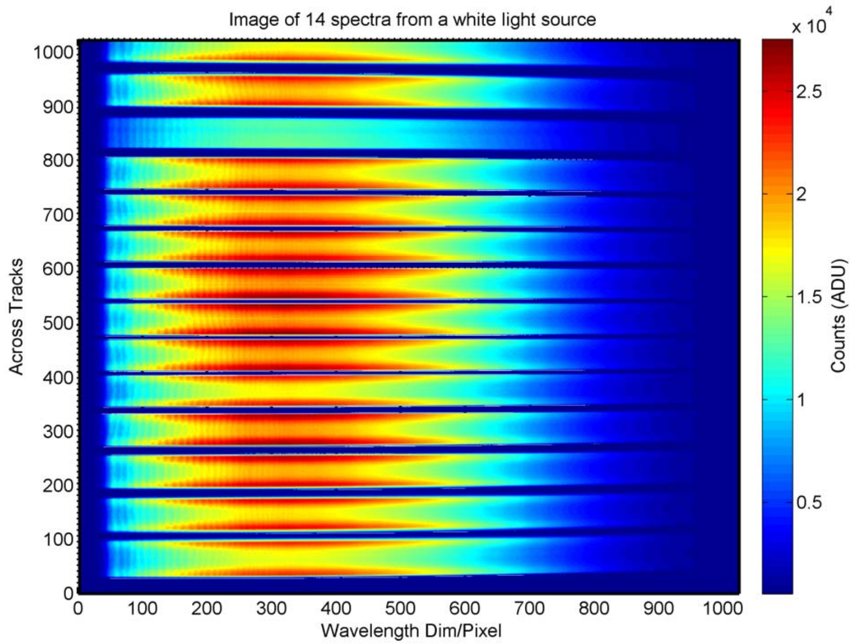
A lot of preparation was done between MOBY-Net and MarONet

Back in May 2019, checking assembly of CF Buoy, tested bending of buoy

Spars were filled with foam for added rigidity (and some flotation), October 2019.

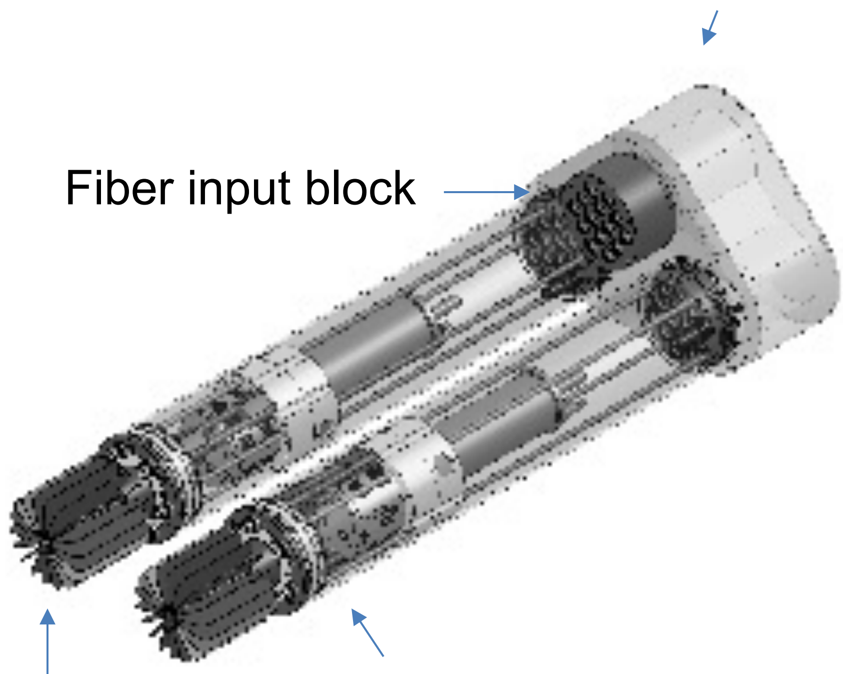
Structure tested at sea for wave handling and strength. Currently finishing a few final modifications

Optical system



Splitter housing

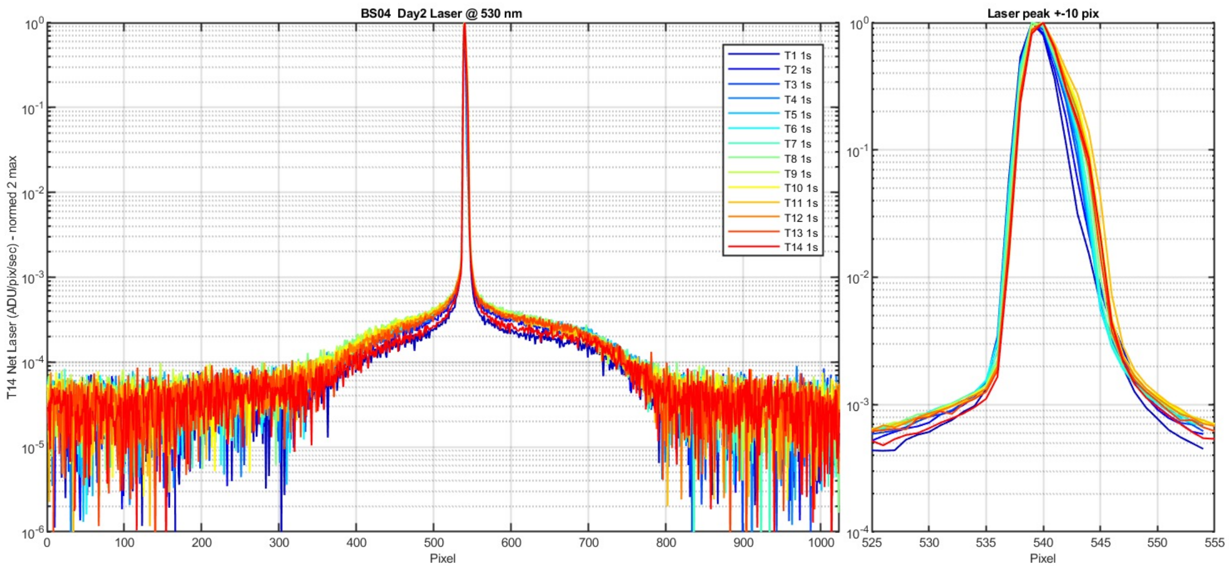
Fiber input block



Red and Blue spectrographs

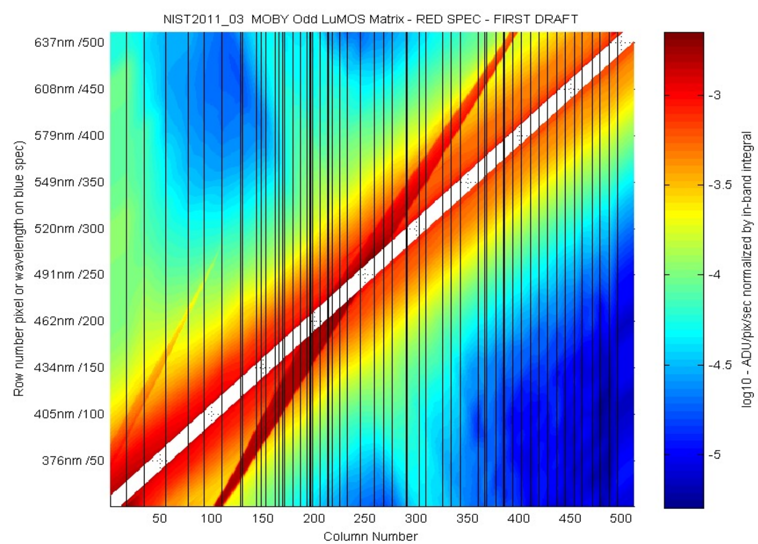
Each spectrograph can acquire 14 channels of data, if desired, simultaneously

Spectral Straylight



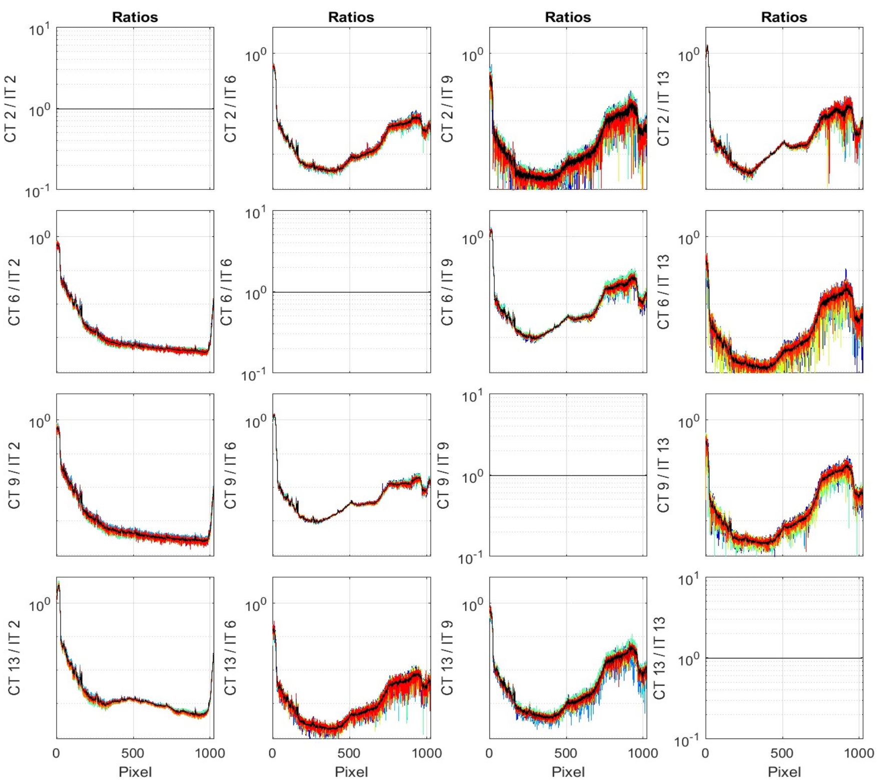
Data taken at many wavelengths, with single wavelength input, as in above example.

Laser system, allows computer control of output wavelength

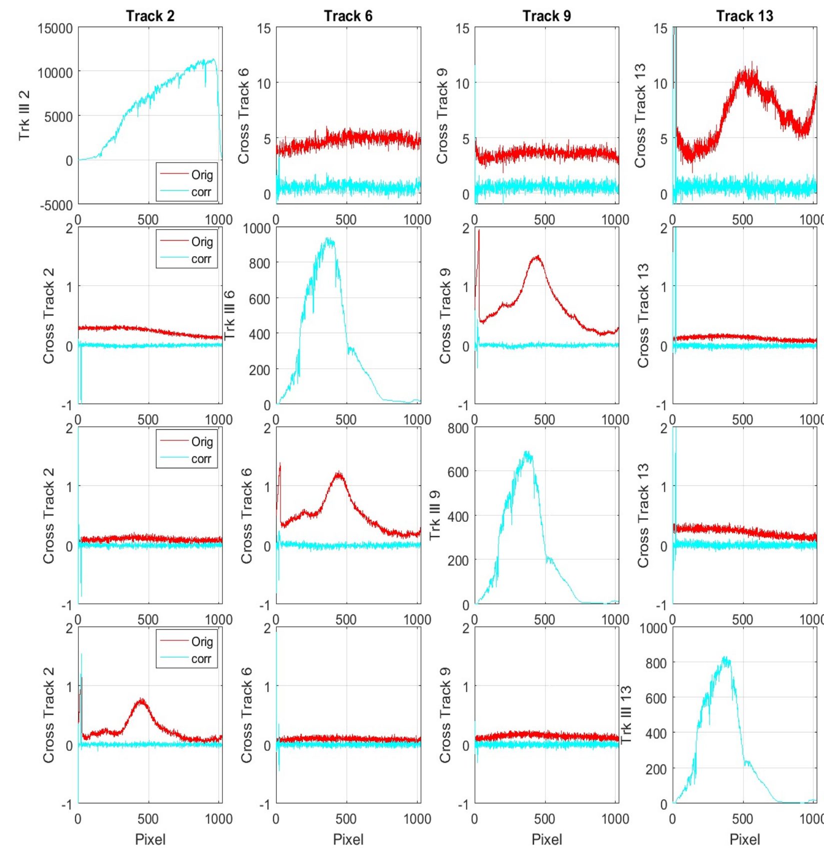


Final result (example is current MOS system)

Spatial Straylight, characterization can be done with at sea data by individually turning on one track, and seeing the effect on the others. Advantage is same spectral shape



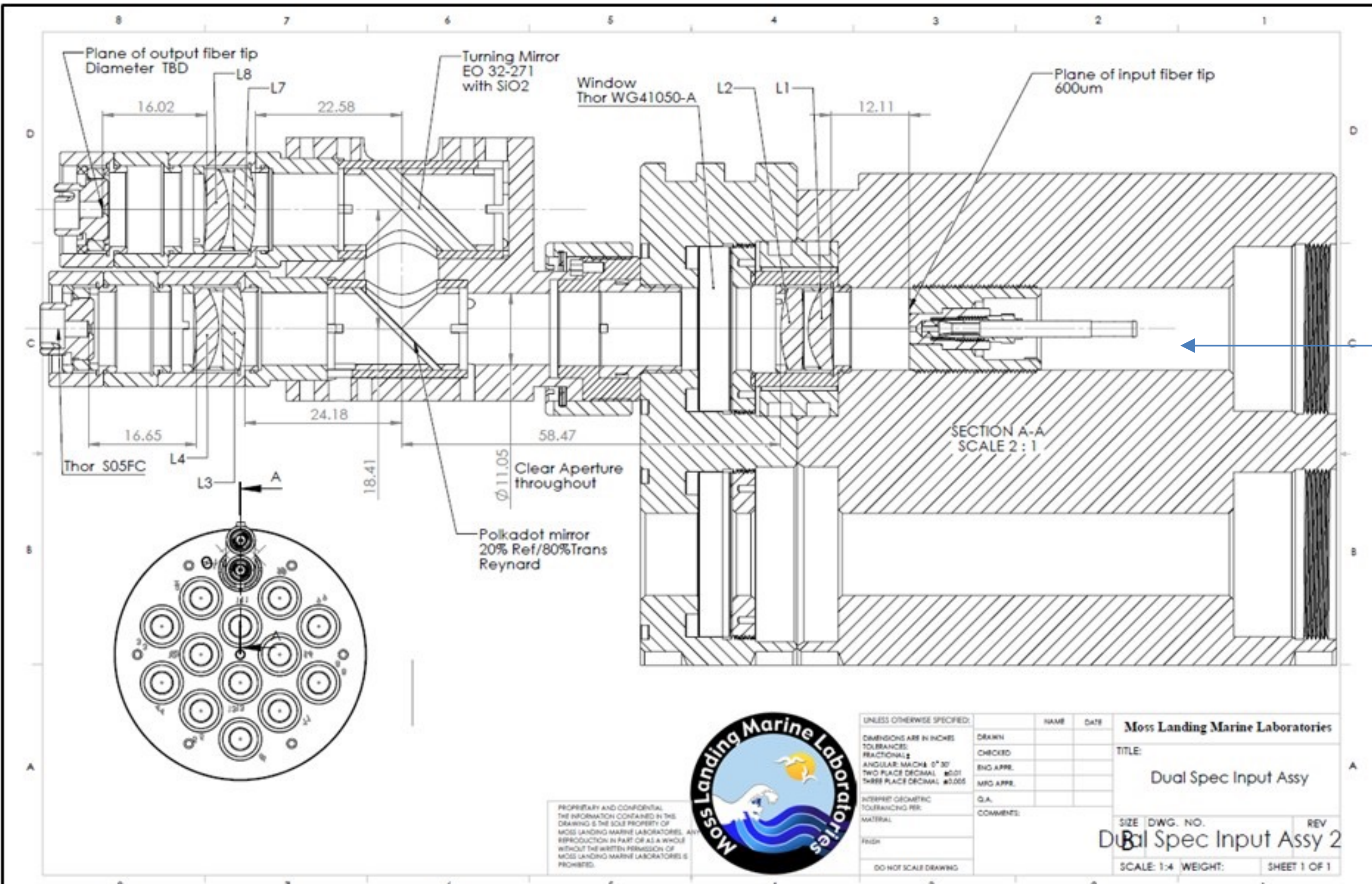
Example showing matrix to invert for cross track straylight on tracks 2, 6, 9, and 13.



Showing data corrected with matrix, off diagonal elements should be zero, and have been corrected to be zero by using the matrix on the left.

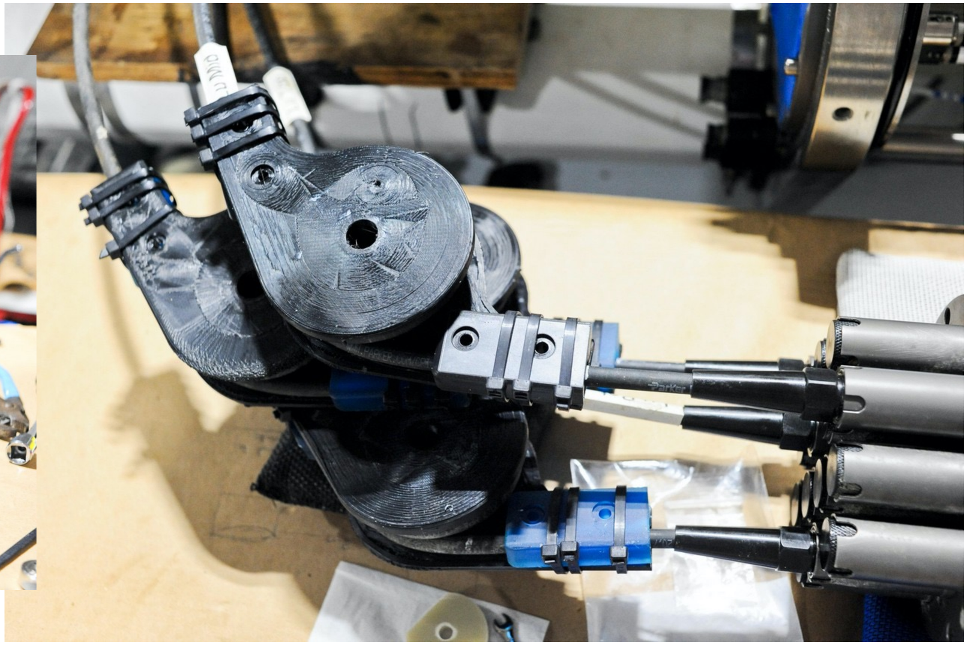
Optical issues solved

We found that we were getting instability due to light mode structure changes in the fiber and its interaction with the beam splitter. When you bend a fiber you change the angular distribution of light coming out of the fiber, which a collimator turns into a spatial distribution. Polka dot beam splitter is as it sounds, a polka dot mirror.

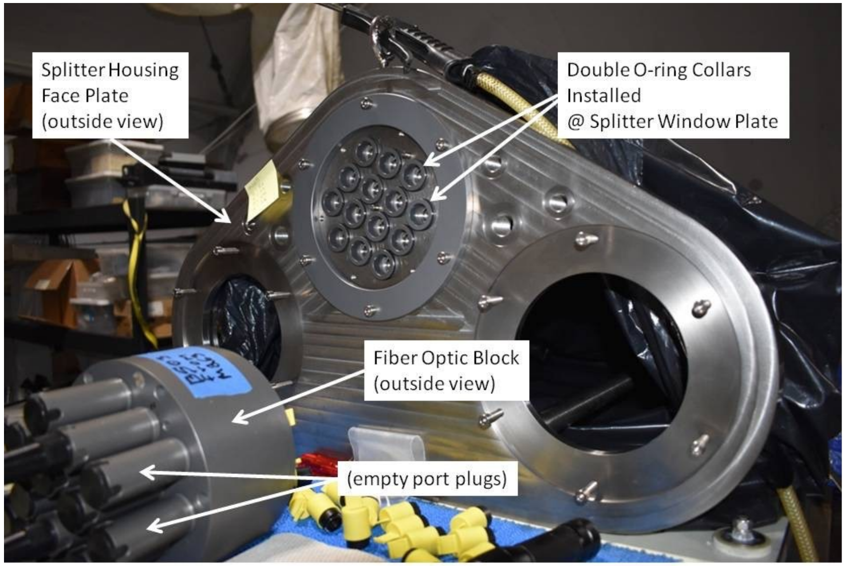


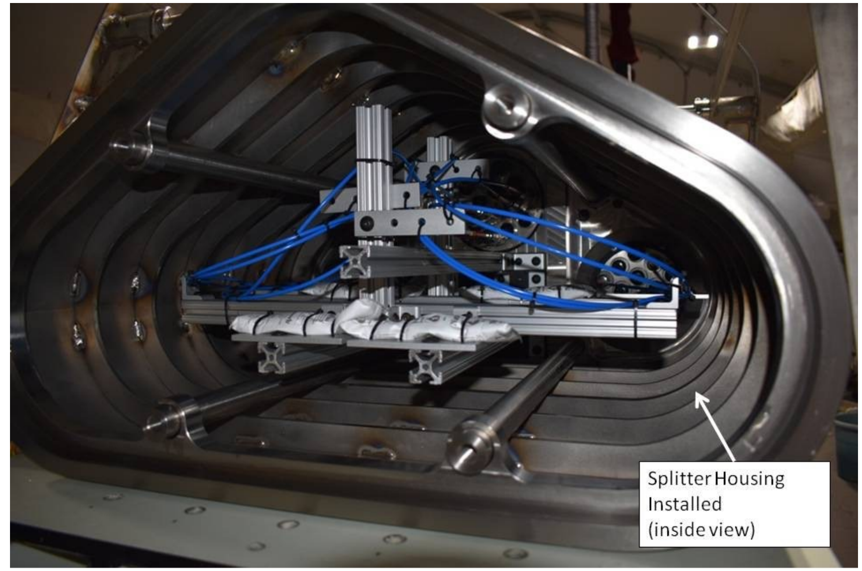
Fiber input

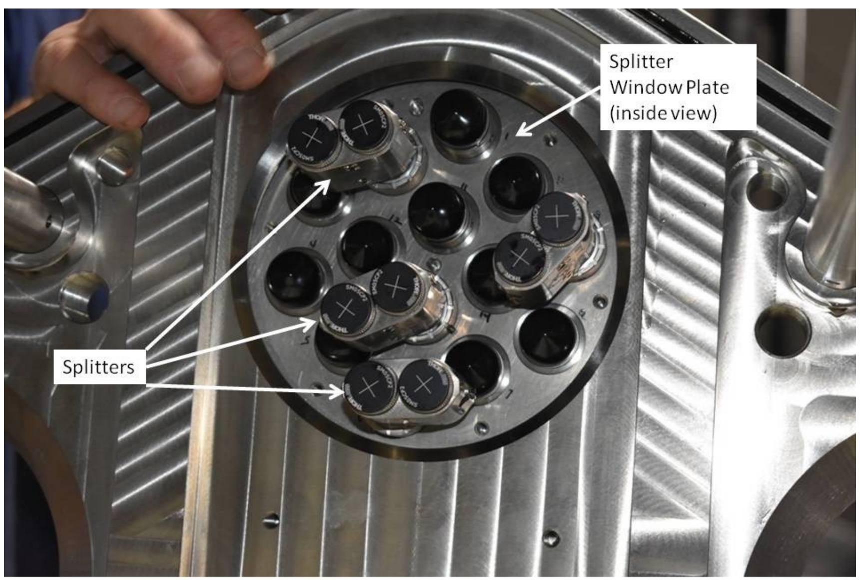
Solution was to introduce mandrels before light went into the beam splitters which forced the fibers into tight bends, mixing up the light modes in the fiber and evening them out.

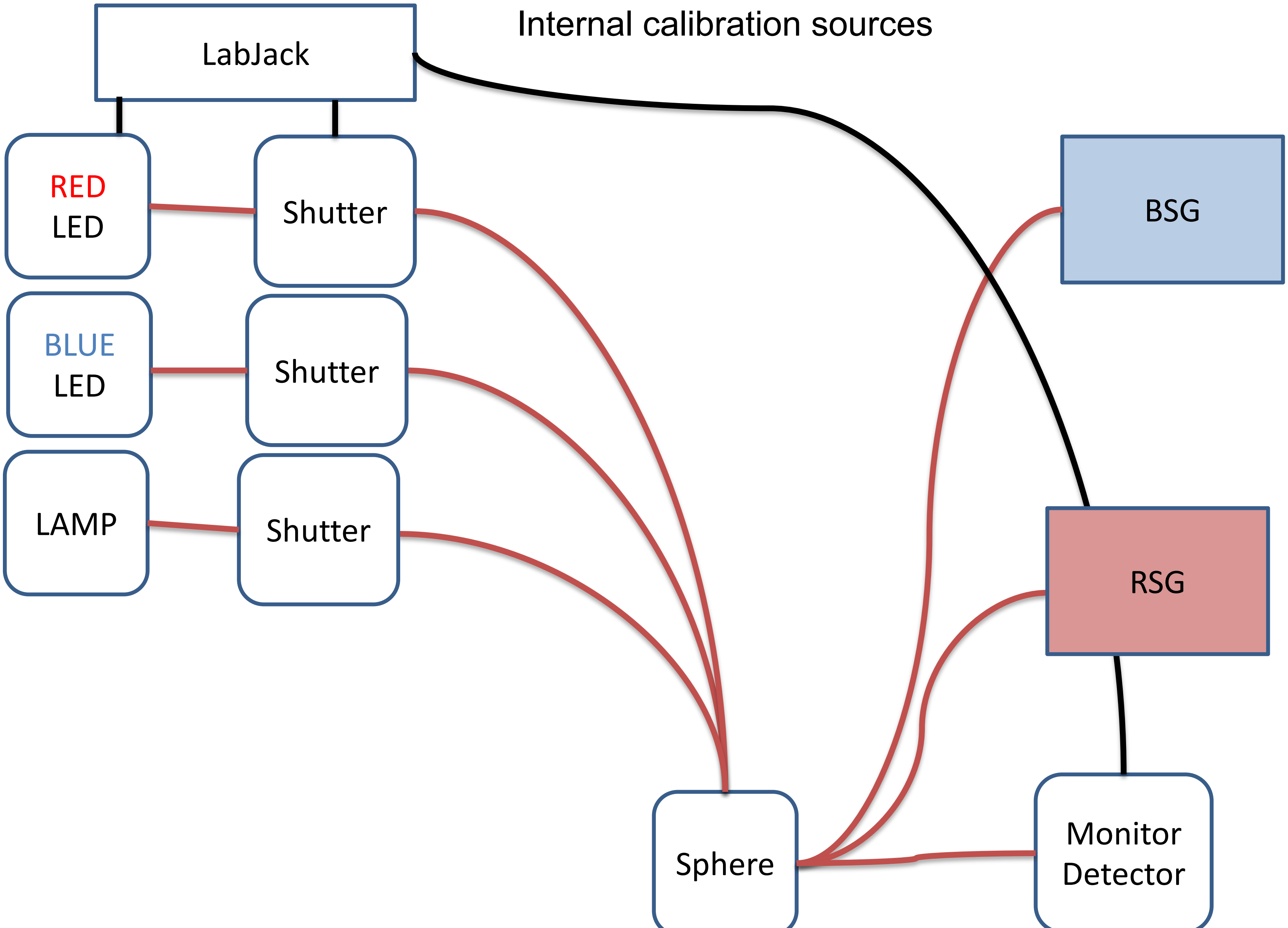


Example Splitter Housing assembly (prototype being thermally tested now)

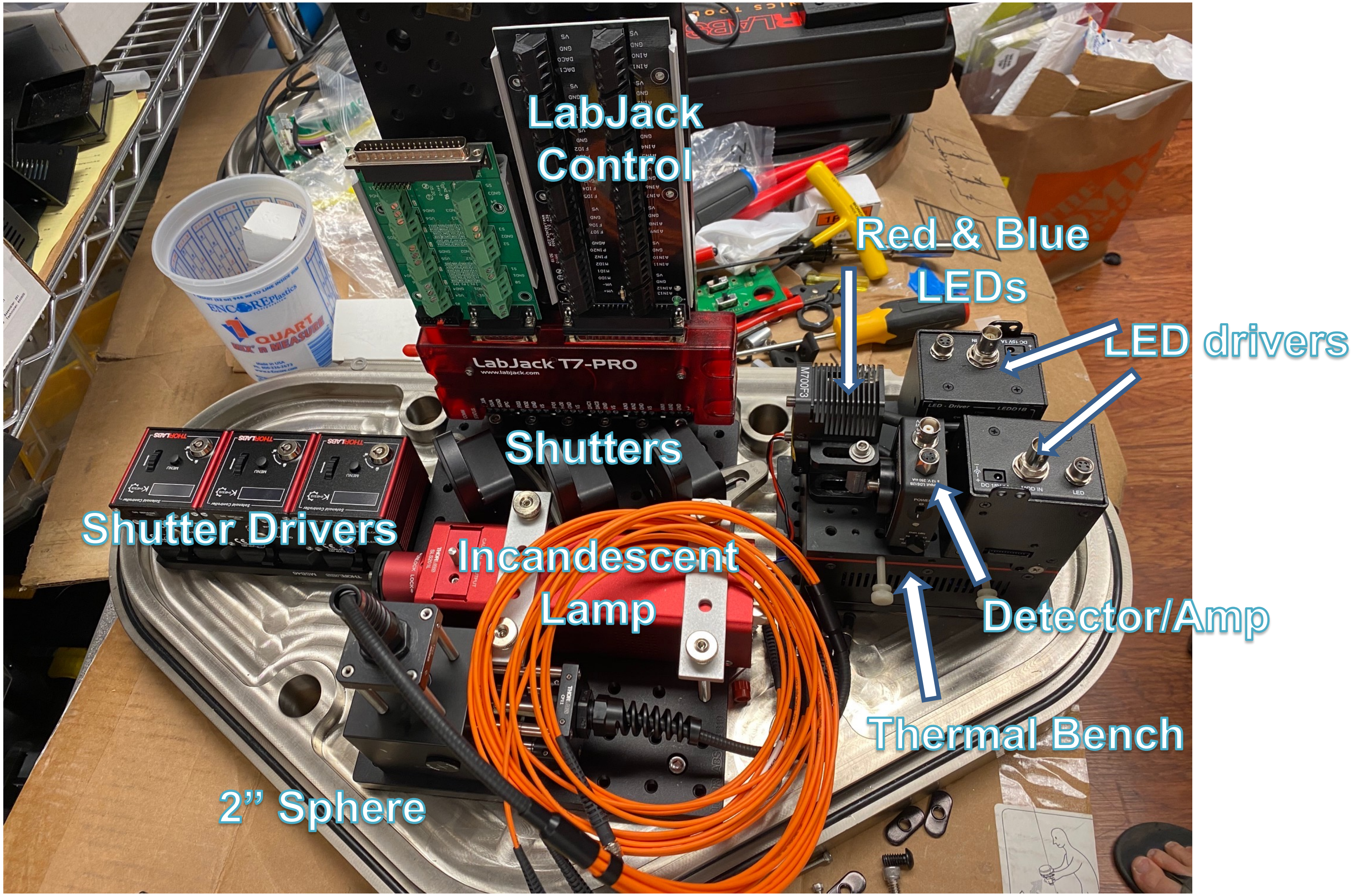







LabJack
Internal calibration sources
RED
LED
Shutter
BLUE
LED
Shutter
LAMP
Shutter
BSG
RSG
Sphere
Monitor
Detector

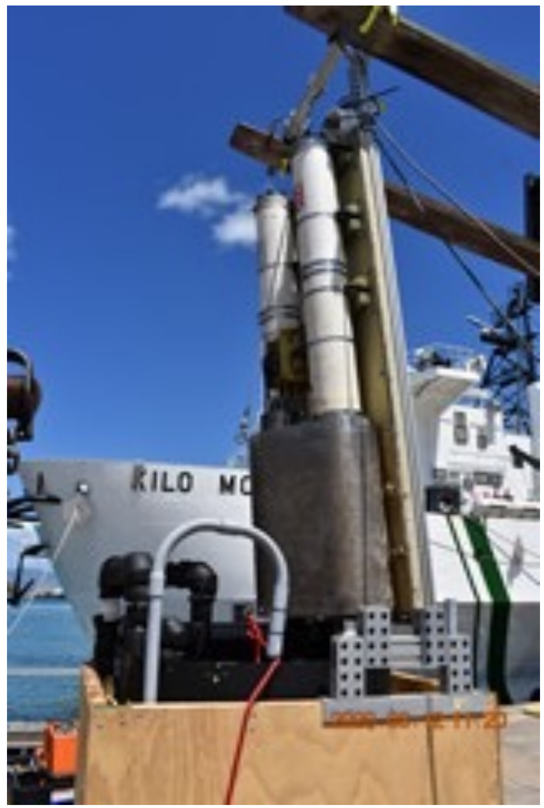
Internal calibration sources being built up for MarONet-1



Initial thermal characterization of complete prototype optical system.

Very preliminary results are enlightening.

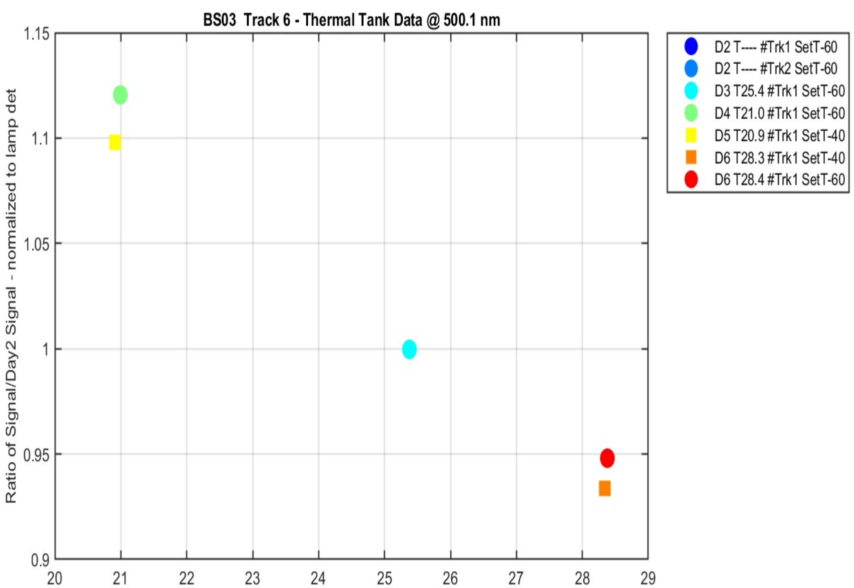
An insulated tank and water heating/cooling system was built that could hold the entire instrument, intact, to be able to do full system characterization, with controlled water temperatures.

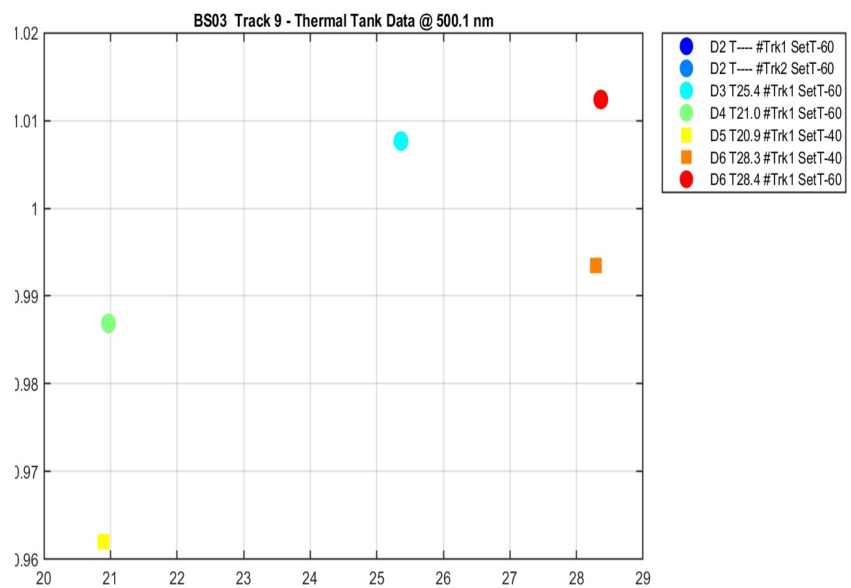


The experiment was set up using two tracks, each, on the Blue spectrograph (BSG) and Red (RSG) spectrograph.

On each spectrograph, Track 6 had a fiber which was 623 cm long, with 449 cm in the water. Track 9 had a fiber which was 328 cm long but was completely out of the water.

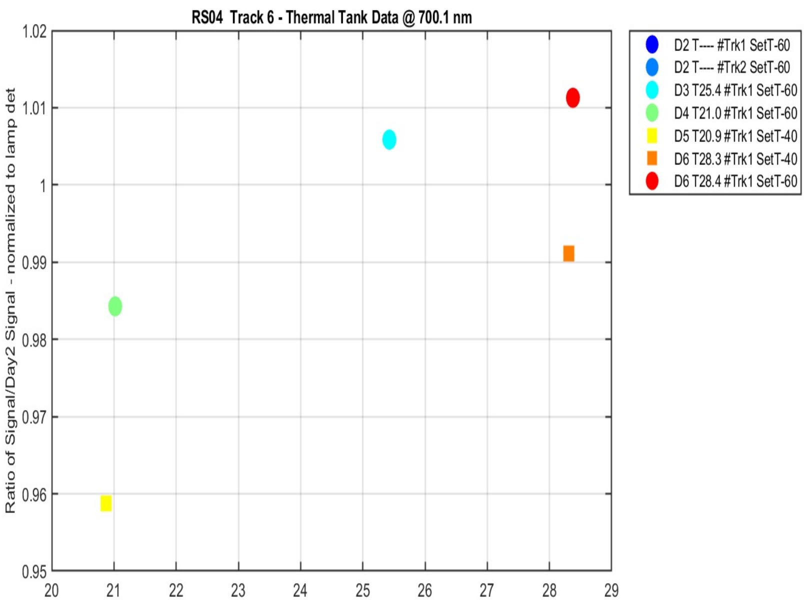
For the BSG track 6 showed significant thermal sensitivity (-15% from 21 to 29 C), while track 9 did not show the same sensitivity (+3% from 21 to 29 C)

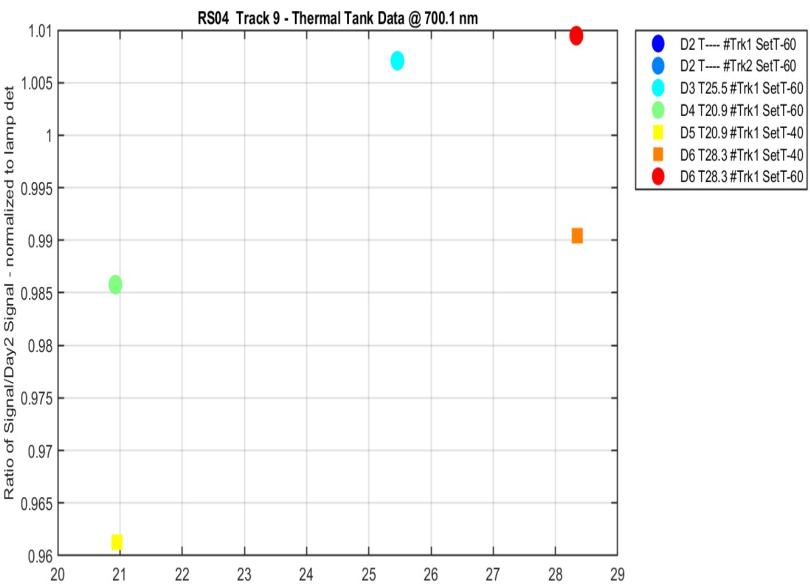




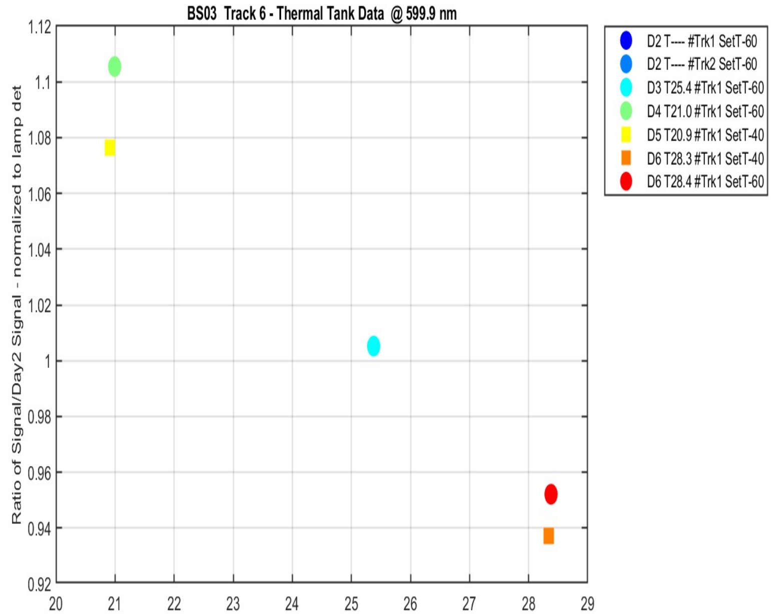
However the RSG showed roughly the same sensitivity for both track 6 and 9 at 700 nm.

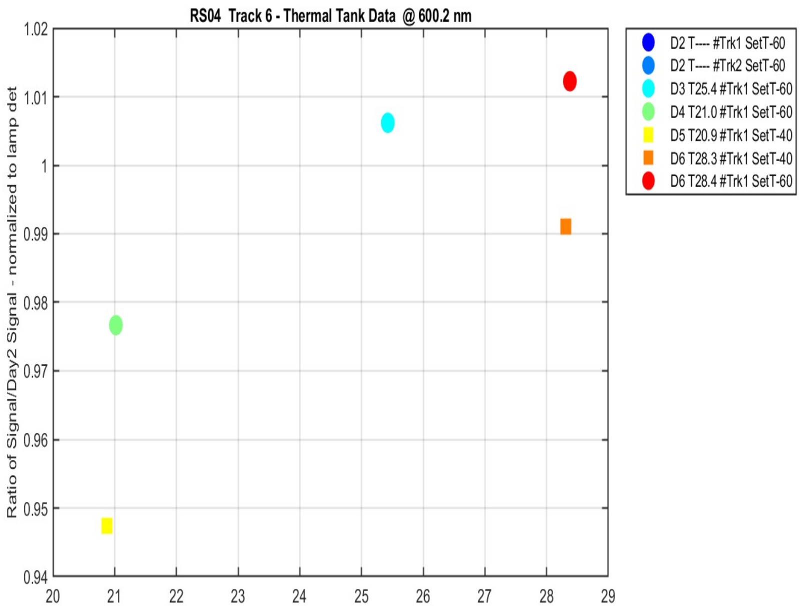
This made us question whether the sensitivity was caused by the fiber being in the water and a spectrally dependent effect on the temperature of the fiber, or some other factor.

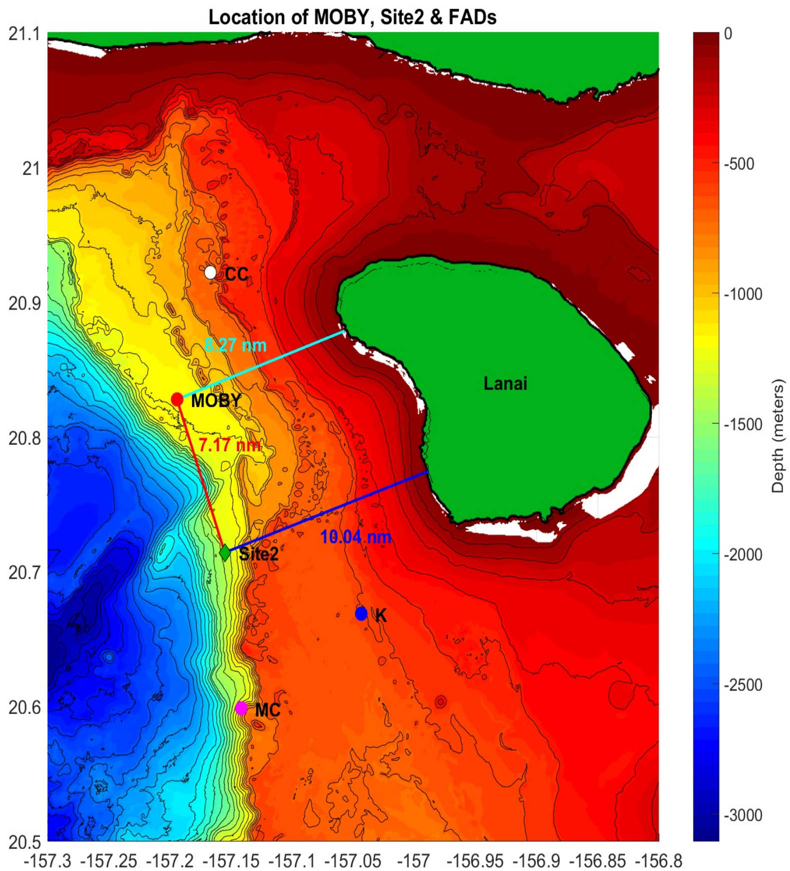




Fortunately we have an overlap region between the two spectrometers so could compare the red spec and the blue spec at the same wavelength (600 nm). For track 6 (fiber in the water), the RSG thermal behavior was consistent with track 9 (shorter fiber, not in water), while the BSG behavior in track 6 was consistent with the behavior at 500nm for the BSG. So the fiber being in the water is not the problem, but rather different behavior for Track 6 on the BSG. We have done additional tracks on the system and confirmed Track 6 is “special”. This shows us that we need to do the thermal characterization for every track of each instrument to check for anomalous behavior, since much of the optical train is unique.







So the stage we are at now:
Beginning characterization of full system 1 to get systems in the field

Test Deployment in June, full deployment on 2nd mooring in later June

Deployment of second system in October

Recovery of system in December, and begin moving equipment to Australia, and finishing up processing of test deployments